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ABSTRACT

The purpose was to investigate changes in attitudes towards mathematics which occurred over a three year period in relation to mathematics achievement, sex, reading achievement, and I.Q. Scores were obtained for 120 fourth graders in a small school system through the use of an attitude scale (adapted from a School Mathematics Study Group (SMSG) scale) and through the regular school testing program. Results showed attitudes to be stable but differences were found in the relationship of attitude to mathematics achievement for boys and for girls. Attitudes towards mathematics were found to be less valuable for predicting achievement for boys and for girls. Attitudes towards mathematics were found to be less valuable for predicting achievement than other variables. (Author/DT)

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THE RELATIONSHIP OF ACHIEVEMENT AND ATTITUDES TOWARDS MATHEMATICS IN THE ELEMENTARY SCHOOL: A LONGITUDINAL STUDY

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Abstract

The purpose of this study was to investigate changes in attitudes towards mathematics which occurred over time and their relationship to selected other variables (I.Q., Mathematics Achievement, Reading Achievement, Sex). Scores were obtained by an attitude scale (adaptation of an S.M.S.G. scale) and through the regular school testing program on 120 fourth graders in a small school system. Scores were obtained for three consecutive years. Attitudes were found to be stable but differences were found in the relationship of attitude to mathematics achievement for males and females. Attitudes to mathematics were found to be less valuable for predicting achievement than other variables.

Improving attitudes increases the likelihood of higher achievement. To many educators that statement is an axiom, a view supported by Aiken (1970, p. 558) when he wrote that "The relationship between attitudes and performance is certainly the consequence of a reciprocal influence in that attitude affects achievement and achievement, in turn, affects attitude." This belief is also expressed by Suydam and Riedesel (1969, p 641) "Pupil attitude to mathematics is related to intelligence and achievement."

These generally accepted viewpoints have, of course, an empirical basis which has been reviewed by the authors cited above. There are, however, several studies which do not support this view. Kean (1968) in a study of intermediate grade students found no relationship between student attitude towards arthimetic and their achievement in that subject. Higgins (1969) in a study of eighth graders concluded that differences in attitude towards mathematics were not reflected in either ability or achievement differences. Neale (1969) after finding that attitudes towards mathematics accounted for only .019 of the variation in post test arithmetic achievement concluded that the role of attitudes in mathematics achievement was extremely small.

Somewhere between these two ends of the continuum, there are numerous studies which have found some degree of relationship between attitudes and achievement, as for example, reported by Antonnen (1967) and Husen (1967).

Such discrepancies should not be unexpected, and are, in fact, quite easily explained. Researchers have studied different populations, used different achievement and attitudinal measures, even different

definitions of attitude, and in the absence of a meaningful reference point have made different interpretations of similar findings. Such reference points can only be established through a systematic longitudinal study of the same population sample using the same measures. In the absence of such a study, one may formulate conclusions with respect to the relationship between mathematical attitudes and achievement, and with respect to the role of such variables as intelligence and sex, but the more important questions must remain unanswered. What happens to these relationships over a period of time? What changes in attitude occur over time? Is the relationship between attitude and achievement stable? Is the influence of intelligence or attitudes constant over time? Are these changes, if any, in relationships which occur the same for boys and girls?

The purpose of this study was to investigate changes in attitude towards mathematics over time in relation to mathematics achievement, sex, reading achievement and I.Q.

Subjects: The sample originally consisted of the entire fourth grade of a small Southern Illinois school system, 120 students. Only subjects for whom complete data was obtained over the entire three-year period are included in this study. Thus, the sample consists of 68 children, 45 of whom were boys.

Instruments: The test used to measure mathematics attitudes in this study was a subset of items from the National Longitudinal Study of Mathematical Abilities Attitude Inventory (S.M.S.G. 1968) which has had a long and careful development. Although the scale used was

designed for use with fourth grade students, examination revealed a number of flaws. The inventory of seventy items was considered to be too long, and many of the items involved making distinctions of feeling considered too fine for elementary grade students. The response pattern of the inventory was inconsistent also. Consequently, permission to adapt the instrument was obtained from the publishers and a number of changes made. The length was reduced to thirty items, working was simplified and clarified and the response pattern made consistent. Reliability of the instrument was obtained by test-retest using a sample of 45 third, fourth and fifth grade students from a nearby elementary school. The interval between tests was one week and a reliability coefficient of .72 was obtained. The instrument was validated during the study by having the students rank mathematics in relation to other subjects. The overall correlation between the ranking and the attitude score was consistently over -0.6 and reached as high as -0.85 for the boys. A negative value in this instance, of course, indicates agreement between the two measures.

The achievement and intelligence scores used in the study were obtained through the regular school evaluation program.

Procedure: Each April, for three consecutive years, just prior to the regularly scheduled administration of the standardized achievement tests, the attitude inventory was administered for all subjects by their own classroom teacher. The teachers all followed a similar procedure by discussing sample items with the children, explaining any words or items that children did not understand and by discussing the difference between such terms as "agree a lot" and "agree a little."

Measures on all subjects with regard to I.Q., reading and mathematics achievement scores and sex were obtained from school files. The attitude inventories were hand-scored. Subjects were identified only by number. Due to a clerical error, reading scores for the first year were not obtainable.

Analysis of Data: To this point the analysis of data has been descriptive in nature and accomplished by means of an SPSS Stepwise Regression Analysis. In addition to giving means, standard deviations and correlation coefficients, Stepwise Regression orders a set of variables according to their predictive ability.

Results: Descriptive data obtained in the study are presented below. In Tables III. - V. the following abbreviations are used:

MA1 - First Year Mathematics Achievement Score (4th Grade)

MA2 - Second Year Mathematics Achievement Score (5th Grade)

MA3 - Third Year Mathematics Achievement Score (6th Grade)

ATT1 - First Year Mathematics Attitude Score

ATT2 - Second Year Mathematics Attitude Score

ATT3 - Third Year Mathematics Attitude Score

IQ1 - First Year I.Q. Score

IQ2 - Second Year I.Q. Score

IQ3 - Third Year I.Q. Score

RA2 - Second Year Reading Achievement Score

RA3 - Third Year Reading Achievement Score

Table I. Mean Attitude, Intelligence and Achievement Scores by Year

Year	1	2	3
ATT	102.32	113.85	110.55
IQ	111.43	112.00	109.63
MA*	5.16	6.38	8.23
RA*		8.52	8.08

*These values are in grade level equivalents

Table II. Correlation Coefficients for Selected Variables by Year

Year	I	2	3
MA/ATT	.335	.259	.202
ATT/IQ	.443	.236	.005
MA/IQ	.543	.795	.674
RA/IQ		.144	.534
RA/MA		.202	.768

Table III. Summary Table for First Year Stepwise Regression

Analysis: Dependent Variable, First Year Mathematics Achievement

Variable	R Square	RSQ Change	Simple R
IQ1	.2946	.2946	.543
ATT1	.3057	.0111	.335

Table IV. Summary Table for Second Year Stepwise Regression Analysis: Dependent Variable, Second Year Mathematics Achievement

Variable	R Square	RSQ Change	Simple R
IQ2	.6317	.6317	.795
MA1	.7549	.1232	.789
RA2	.7596	.0047	.202
ATT1	.7624	.0028	.323
ATT2	.7640	.0016	.259
IQ1	.7647	.0007	.661

Table V. Summary Table of Third Year Stepwise Regression Analysis: Dependent Variable, Third Year Mathematics Achievement

Variable	R Square	RSQ Change	Simple R
MA2	.7406	.7406	.861
RA3	.8007	.0600	.768
ATT2	.8119	.0112	.308
MA1	.8193	.0074	.744
ATT1	.8217	.0024	.353
RA2	.8236	.0019	.138
ATT3	.8254	.0018	.202
IQ2	.8262	.0008	.747
IQ1	.8268	.0006	.620
IQ3	.8271	.0003	.674

Table VI. Correlation Coefficients of Selected Variables by Sex and Year

Year		1	2	3
MA/Att	M	.278	.292	.358
	F	.412	.275	.098
IQ/ATT	M	.467	.192	-.04
	F	.465	.287	.046
IQ/MA	M	.510	.798	.669
	F	.554	.801	.693

Table VII. First Year Summary of Stepwise Regression Analysis: Males

Variable	R Square	RSQ Change	Simple R
IQ	.2599	.2599	.5098
ATT	.2619	.0020	.2777

Table VIII. First Year Summary of Stepwise Regression Analysis: Females

Variable	R Square	RSQ Change	Simple R
IQ	.3068	.3068	.554
ATT	.3372	.0304	.412

Table IX. Second Year Summary of Stepwise Regression Analysis: Males

Variable	R Square	RSQ Change	Simple R
MA1	.6823	.6823	.826
IQ2	.8152	.1329	.798
IQ1	.8218	.0066	.694
ATT1	.8257	.0039	.320
ATT2	.8355	.0076	.292
RA2	.5371	.0016	.649

Table X. Second Year Summary of Stepwise Regression Analysis: Females

Variable	R Square	RSQ Change	Simple R
IQ2	.6413	.6413	.801
MA1	.7375	.0962	.779
ATT1	.7474	.0099	.341
RA2	.7531	.0057	.196
IQ1	.7579	.0048	.648
ATT2	.7579		

Table XI. Third Year Summary of Stepwise Regression Analysis: Males

Variable	R Square	RSQ Change	Simple R
MA2	.7038	.7038	.840
RA2	.8066	.1028	.788
ATT3	.8355	.0289	.358
IQ3	.8645	.0289	.669
ATT1	.8753	.0108	.460
RA3	.8851	.0043	.794
ATT2	.8885	.0034	.431
IQ2	.8911	.0027	.776
MA1	.8927	.0015	.758
IQ1	.8929	.0003	.703

Table XII. Third Year Summary of Stepwise Regression Analysis: Females

Variable	R Square	RSQ Change	Simple R
MA2	.7621	.7621	.873
RA3	.8087	.0466	.753
MA1	.8178	.0092	.740
ATT2	.8227	.0048	.260
ATT3	.8303	.0076	.099
RA2	.8381	.0078	.108
IQ2	.8419	.0038	.730
IQ1	.8457	.0037	.588
IQ3	.8478	.0021	.693
ATT1	.8502	.0024	.306

DISCUSSION

Attitude Changes: No trend is apparent in the changes in mean attitude scores for the group as a whole. It can not be said that attitudes towards mathematics either worsen or improve as children progress through the upper elementary grades.

Relationship Between Mathematics Achievement and Attitude Towards Mathematics: In each of the three years a positive correlation was found between mathematics achievement and attitudes towards mathematics for the entire group. This correlation became systematically smaller, possibly indicating that attitude has a lesser influence on achievement in mathematics as children progress through the grades. This view is supported by the fact that attitudes towards mathematics were much less useful in predicting mathematics achievement than other variables. It is worth noting too, that in the second and third years, the previous year's attitude score was a better predictor of achievement than the current year's score.

Relationship between Mathematics Achievement and Intelligence: In each of the three years a fairly consistent moderate correlation was observed between mathematics achievement and I.Q. This correlation was higher than between reading achievement and I.Q. However, the usefullness of I.Q. as a predictor of mathematics achievement was by no means constant. In year one I.Q. was the most useful predictor but accounted for only .2946 of the variance in year one. In year two I.Q. was also the most useful predictor of achievement, this time accounting for .6317 of the variance. In the third year, however, prior achievement in mathematics was the most useful predictor of mathematics achievement, and once prior

achievement was known, I.Q. contributed little to the ability to predict achievement.

Relationship Between I.Q. and Attitude Towards Mathematics: In each of the three years a positive correlation was found between I.Q. and attitude towards mathematics. This correlation decreased each year until it was essentially zero. This finding is contrary to what one would expect with increasingly formal instructional methods and mathematics content.

Relationship Between Reading Achievement and Mathematics Achievement: No reading score was available for the first year. The second year produced a surprisingly low correlation coefficient between these two variables. The Stepwise Analysis would appear to indicate that the value obtained in the third year of the study more accurately reflected the relationship between reading and mathematics achievement, with reading achievement being the record most useful predictor of mathematics achievement, second only to prior mathematics achievement.

Sex Differences: The Relationship between I.Q. and attitudes displayed a similar downward trend for both males and females, and the relationship between I.Q. and mathematics achievement was stable for both series also. However, the relationship between mathematics achievement and attitudes as measured by simple correlation coefficients were strikingly different. For males the correlation value increased each year, while for females the value decreased each year to almost zero. Once prior achievement, I.Q., and reading scores were known, however, knowledge of attitudes adds little to the ability to predict achievement in mathematics for either sex.

Summary: From the descriptive anlaysis of the data made it may be said that the mathematical attitudes of the subjects in the study were stable with no definite trend. There was a positive but decreasing correlation between achievement in mathematics and attitude towards mathematics and attitude scores were less useful than other variables in predicting achievement. I.Q. was a useful predictor of mathematics achievement in the first two years, but became of decreasing importance as a factor in attitudes towards mathematics. The relationship between mathematics achievement and attitudes towards mathematics was different for males and females.

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